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SUBJECT CODE NO:- B-2017
FACULTY OF SCIENCE & TECHNOLOGY
B.Sc. T.Y (Sem-V)
Examination November/December- 2022
Physics Paper-XV
(Classical & Quantum Mechanics)

[Time: 1:30 Hours] **[Max. Marks: 50]**

Please check whether you have got the right question paper.

N.B i) All questions are compulsory
ii) Figure to the right indicate full marks.

Given data:-

$k=1.38\times10^{-23}$J/K
$R=8.31\times10^{3}$ J/k mole K
$\mu_o=4\pi\times10^{-7}$ Wb/Amp
$C=3\times10^{8}$ m/s
$h=6.63\times10^{-34}$ J.S.
$me= 9.1\times10^{-31}$ kg
$e=1.6\times10^{-19}$C
$1ev= 1.6\times10^{-19}$J

Q. 1 (a) Using Newtons law of motion, deduce the conservation theorem of linear momentum, angular momentum and energy for the motion of a particle. 10

(b) Obtain an expression of plank's radiation Law, Deduce Wein's displacement Law from plank's Law. 10

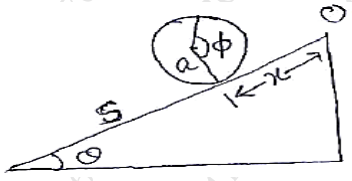
OR

(a) Show that for a de-Broglies wave group associated with a moving particle. The group velocity is equal to particle velocity. 10

(b) Explain the term operator. Derive an expression for 10
(i) Linear momentum operator (ii) Energy operator.

Q. 2 (a) What are constraints? Classify the constraints and explain any one in detail. 05

(b) Fig. shows a cylinder of radius 'a' and mass 'm' rolls down an inclined plane making and angle 'θ' with the horizontal. Set up the Lagrangian and find the equation of motion. 05



State Heisenberg's principle. Obtain uncertainty in time and energy.

(c) 05

An electron has speed of 500 m/s with an accuracy of 0.006% calculate the certainty with which

(d) we can calculate position of electron. 05

OR

Explain plank's quantum postulates.

(a) 05

The work function of sodium metal is 3.2eV. What is longest wave length of light that can cause

(b) photoelectric emission from sodium. 05

Write a note on expectation value.

(c) 05

Calculate the energy difference between the ground state and the first excited state for an

(d) electron in a box of length $1A°$. 05

Q. 3 Multiple choice questions 10

1. The rate of change of angular momentum is _____
   a) Torque b) Moment of inertia c) Acceleration d) None of these

2. Lagrangian's equation are applicable when the system is
   a) Conservative b) Non conservative c) Linear d) Both a and b

3. $\lambda m\alpha \frac{1}{T}$ represents_____
   a) Weins law b) Plancks law c) Ruther Ford law d) Hook's law

4. The absorptive power of a perfectly black body is
   a) 0.5 b) ∞ c) Zero d) 1

5. The de-Broglies wavelength is independent of_____
   a) Mass b) Velocity c) Momentum d) None of these

6. The concept of duality is firstly proposed by _____
   a) Taylor b) Einstein c) De-Broglies d) G.P. Thomson

7. For a free particle potential energy is _____
   a) ∞ b) 0 c) 1 d) -1

8. The wave function must be_____
   a) Single valued b) Continuous c) Finite d) All above

9. Operator form the time dependent Schrodinger equation is _____
   a) $H\psi=1$ b) $H\psi= E\psi$ c) $H\psi=A$ d) None of these

10. The probability of finding a particle in a distance dx around a point x is _____
    a) ψ^* b) $\psi\psi^*$ dx c) $\psi\psi^*$ d) ψ